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GRASSLAND AND RELATED VEGETATION IN NORTHERN MEXICO

Forrest Shreve

The extensive grassland area of the central United States exhibits its optimum development in Kansas and Nebraska, and extends south to the Mexican boundary only after suffering localization in occurrence and modification in character. The plains and gently falling outwash slopes of southern New Mexico and western Texas are largely occupied by a very open type of arid grassland in which *Yucca, Nolina, Dasylirion, Agave, Opuntia* and various shrubs are conspicuous. This is a transition region, in which the conditions are intermediate between the optimum ones for grassland and for desert. The vegetation is formed by an infiltration of plants from each of these vegetations, with very few dominant species that are distinctive of the transition region. In both of the states mentioned and also in southeastern Arizona there are areas of true grassland growing in favorable valleys or

circling the higher mountains, and in all cases occupying relatively deep soils at elevations of 1500 to 1800 meters.

At higher elevations in northern Mexico, where climatic and soil conditions are favorable, there are some large areas of grassland. These are chiefly along the eastern base of the Sierra Madre Occidental and around the higher mountains of northern Coahuila. Grasses are also important in the transitions from grassland to encinal (evergreen oak woodland), to juniper or pinyon woodland, and to oak chaparral. Grasses are likewise important in the cactus-acacia-grassland ("cactus savanna"), which lies between the southernmost areas of desert and the grassland. In northern Chihuahua there are a number of "llanos," or grass covered plains, which are not related to the true grassland and its transitions but are distinctly a desert association occurring also in Arizona and Sonora. The aim of this paper is to describe briefly each of these types of vegetation in which grasses play a conspicuous part. Nothing will be said here in reference to the minor rôle played by grasses in the desert, their greater importance in the arid bushland which occupies the low elevations of northeastern Mexico, nor their secondary rôle in the forests of northern Mexico.

Prior to the beginning of the Madero revolution the grasslands of northern Mexico were a source of great wealth. The destruction and expropriation of most of the great cattle ranches gave the grasslands a period of over fifteen years with relatively light utilization. During the last seven years the agrarian program of the Mexican Government has brought some of the best areas of grass into cultivation. A magnificent natural sod has been destroyed in a worthy effort to help inexperienced and poorly equipped farmers to raise profitable crops of corn by dry farming methods. The recent heavy importation of foodstuffs by Mexico, for the first time in its history, is eloquent proof of the difficulties which this program has encountered.

The most extensive grasslands are in central Chihuahua, covering an area indicated on the map accompanying a paper by the writer in this journal (4). A continuous belt of varying width extends south through Durango and Zacatecas into Aguascalientes and northern Jalisco. Most of these areas are in the elevated valleys which lie between the eastern base of the Sierra Madre and the subsidiary ranges which parallel it on the east. In northern Chihuahua grassland is found in suitable situations between elevations of 1600 and approximately 2150 meters. In northern Durango there is a very gradual ascent from the central basin of the Mexican plateau to the summit of the Cuchillo de Zarca at 2000 meters. On this ascent in the region west of Mapimi the desert shrubbery is gradually replaced by grasses, and typical grassland is first met slightly below 1800 meters. In southern Durango, south of the Rio Nazas, grassland is first encountered at 1925 meters and covers a large area in the central

and southern part of the state. Between Nombre de Dios, Durango, and Sombrerete, Zacatecas, broad grassland valleys rise to an elevation of 2500 meters. Similar areas also extend north from the city of Durango but are interrupted by extensive malpais areas. In the 1000 kilometers between northern Chihuahua and central Zacatecas it will be noted that there is a slight increase in the elevations between which grassland is found. In northern Coahuila the scattered belts of grassland lie between 1500 and 1800 meters.

The western face of the Sierra Madre Occidental is more precipitous than the eastern and active denudation has prevented the development of large areas suitable for domination by grasses. In northeastern Sonora there are areas and belts of grassland in localities north of Moctezuma and east of Magdalena. With decreasing altitude the transition from grass to desert is rapid. South of Moctezuma the principal display of grasses is in foothills at elevations of 450 to 900 meters, where coarse bunch grasses grow in the open stands of oak. The Sonoran grasslands are rich in species but differ in composition from the areas in Texas and Chihuahua.

On the eastern side of the Mexican plateau, along the western base of the Sierra Madre Oriental, the physical conditions differ greatly from those on the western side. The mountain axis is not so continuously elevated and has no parallel subsidiary ranges on its landward side. The highest peaks are Cerro Potosi (3800 m.) and Peñon Nevado (3664 m.). Between them, and north of the former, are gaps so low that many desert plants extend over the divide into the drainage of the Gulf of Mexico. Another important feature with reference to grassland is the prevalence of limestone along the mountain front in Coahuila and Nuevo Leon. The reluctant weathering of limestone leaves the soil shallow, the surface stony and the deep pockets of soil few. In Mexico, as in the southwestern United States, the limestone soils do not support heavy stands of grass, and desert invariably extends to much higher elevations on limestone than on other types of rock and their derived soils.

The nearest approach to areas of typical grassland on the eastern side of the plateau has been found between Mier y Noriega and Soledad, Nuevo Leon, in the lee of the Peñon Nevado range. The elevation ranges from 1700 to 2000 meters and the rainfall at a single adjacent station is 500 millimeters. On the pediments and gently rounded ridges which parallel the base of the mountains the cover is rarely more than 50 per cent grass, the remainder being other herbaceous perennials. There are frequent mottes of *Quercus cordifolia* from 5 to 6 decimeters high, as well as other shrubs and semi-succulents of greater frequency than in typical grassland.

The characteristic grasses in this region are *Bouteloua gracilis*,

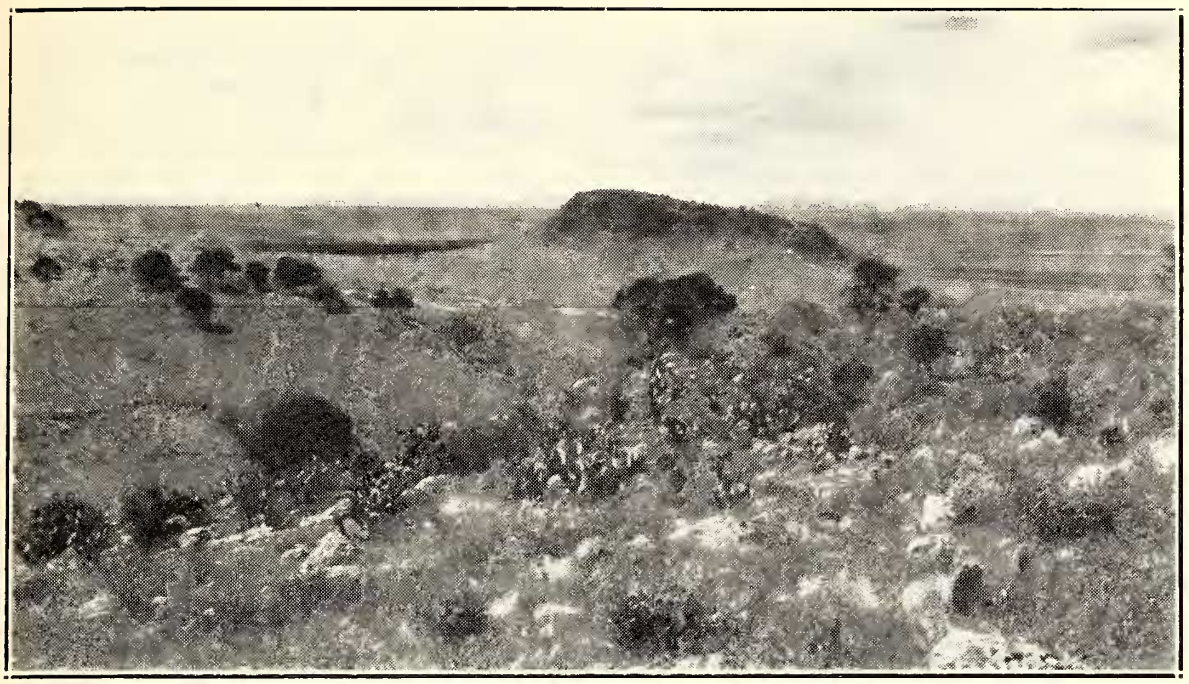

FIGURE 1.

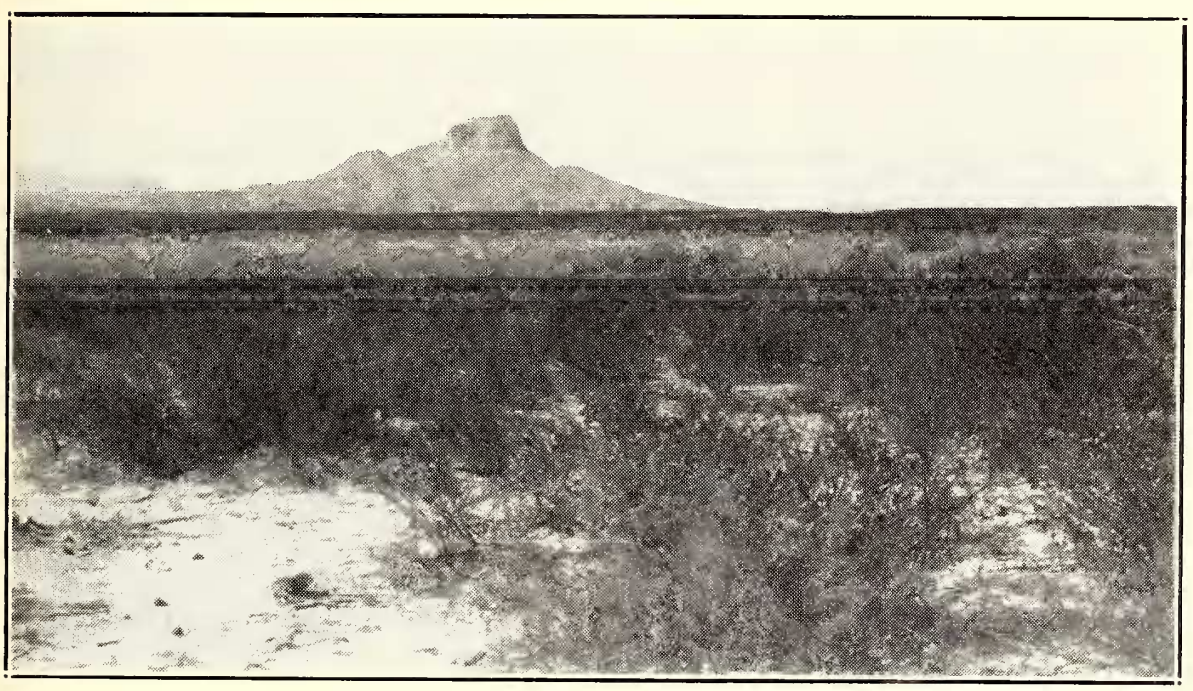

FIGURE 2.

PLATE 25. GRASSLAND IN NORTHERN MEXICO.

PLATE 25. GRASSLAND IN NORTHERN MEXICO. Fig. 1. Looking northeast across the grassland plateau of southern Durango from the lower edge of pinyon woodland in mountains near La Purisima, at 2400 meters elevation. Fig. 2. Looking across bajada with desert shrubbery of *Larrea* and *Acacia vernicosa* to small *Hilaria* llano, 65 kilometers northeast of Camargo, Chihuahua, at 1400 meters elevation.

Triodia grandiflora, Hilaria cenchroides, Lycurus phleoides, and a small slender form of *Bouteloua curtipendula.* The commonest associated plants are *Zinnia anomala, Dichondra argentea, Dyschoriste decumbens, Dyssodia setifolia, Acalypha phleoides, Florestina tripteris* and *Houstonia rubra.*

The precipitation in the Mexican grassland lies approximately between 400 and 500 millimeters on the west side of the central basin and between 500 and 600 millimeters on the east side of the mountains of northern Coahuila. The annual average for the city of Chihuahua, just below the edge of the grassland, is 385 millimeters, while for Parral, just above the grassland, it is 517 millimeters. In the city of Durango the average rainfall is 463 millimeters and at Villa Madero it is 488 millimeters, both localities being in cultivated country that was originally grassland. Charcas, San Luis Potosi, is at 2060 meters elevation on the eastern edge of the grassland, which is only locally and poorly developed there. The average annual precipitation at Charcas is 411 millimeters. Throughout the grassland areas the late winter and spring are dry and the four months, June to September, receive from 64 to 77 per cent of the annual precipitation.

The areas herein designated as grassland are occupied by "short" grasses forming a sod or turf which covers 80 per cent or more of the surface. Cacti over 20 centimeters in height, shrubs and trees are rare or absent. *Yucca, Nolina, Dasylirion* and *Hechtia* are infrequent except at the lowest altitudes and in the transition from grassland to desert. Closely associated with the grasses is a large number of herbaceous root perennials, many of which are prostrate, low, or of habit and leaf size which make them inconspicuous.

The structural and social features of the Mexican grasslands resemble those of the central United States, as described by Clements (1), Weaver and Fitzpatrick (5), Gates (2) and others. The floristic composition is similar to that of western Texas but differs materially from that of Kansas. Among the characteristic grasses of the latter state *Agropyron Smithii, Eragrostis spectabilis, Sporobolus asper, Aristida oligantha, Scheddonardus paniculatus, Stipa spartea* and *S. comata* are absent or very uncommon in Mexico. *Andropogon scoparius* is absent and *A. furcatus* is widespread but nowhere abundant. *Koeleria cristata* is abundant only at high elevations in the grassy forests.

Throughout the most extensive grass areas of Chihuahua and Durango the species of *Bouteloua* greatly dominate over the representatives of other genera. The commonest of these is *B. gracilis,* which is estimated to form at least 80 per cent of the cover in approximately 60 per cent of the grassland area. In the southern extension of the grassland, in Zacatecas and Jalisco, *Bouteloua hirsuta, B. radicosa, Hilaria cenchroides* or *Sporobolus trichodes* alternate or associate as the most common species. Throughout the grassland area large coarse grasses occur spo-

radically or in isolated colonies, including *Andropogon saccharoides, A. barbinodis, Stipa eminens, S. clandestina, Sporobolus airoides, Elyonurus tripsacoides* and *Trichloris mendocina.* Relatively moist areas are heavily carpeted by *Buchloë dactyloides.* Dry localities with shallow soil at low elevations are thickly covered with *Triodia pulchella* or well defined colonies of *Scleropogon brevifolius.* In general, however, the grasslands are as monotonous in composition as they are in their physiognomy.

The following list includes the dominant and frequently recurring grasses of the grassland areas of northern Mexico. The names are approximately in the order of abundance.

Bouteloua gracilis
Bouteloua curtipendula
Bouteloua chondrosioides
Aristida divaricata
Eragrostis mexicana
Bouteloua radicosa
Triodia pilosa
Stipa eminens
Eragrostis diffusa
Lycurus phleoides
Buchloë dactyloides
Triodia grandiflora
Andropogon saccharoides
Aristida ternipes
Eragrostis lugens
Eragrostis intermedia
Hilaria cenchroides
Muhlenbergia monticola
Stipa editorum
Triodia mutica
Scleropogon brevifolius
Sporobolus trichodes
Pappophorum Wrightii
Setaria macrostachya

Grasses which are less abundant over the entire area or only locally common are the following.

Andropogon perforatus
Aristida adscensionis
Aristida glauca
Aristida hamulosa
Bouteloua eriopoda
Bouteloua filiformis
Bouteloua hirsuta
Bouteloua Rothrockii
Elyonurus tripsacoides
Eragrostis limbata
Leptochloa dubia
Muhlenbergia polycaulis
Muhlenbergia rigida
Panicum Hallii
Panicum obtusum
Setaria geniculata
Setaria Grisebachii
Sporobolus airoides
Sporobolus Poiretii
Stipa clandestina
Stipa tenuissima
Trichloris mendocina
Triodia grandiflora
Triodia pulchella

Transition from Grassland to Encinal

At the same altitudes occupied by grassland there also occur extensive stands of encinal (evergreen oak woodland) or open stands of juniper or pinyon. These are almost invariably confined to hills and abrupt slopes or to rocky ground with shallow soil, while grassland occupies level or gently sloping areas with soil from 15 to 50 centimeters or more in depth. In open stands of woodland the floor supports a light cover of grasses which

differs little in appearance and composition from pure grassland. Where the soil is rocky and irregular in depth, and the trees are abundant, a rich variety of herbaceous perennials forms more of the cover than do the grasses.

In central Chihuahua the lower edge of the encinal is often encountered at 1500 meters in very open stands of *Quercus chihuahuensis, Q. santaclarensis* or *Q. Emoryi.* In southern Durango encinal fails to find extensive areas of suitable conditions below 2150 meters, and in several districts grassland extends up to 2500 meters. In both states the texture and depth of soil appear to be the deciding conditions for the dominance of grasses or the appearance of trees. The critical season for trees is the dry period extending from February to May. Nothing is known about the comparative soil moisture of the deep soils and the rocky terrain in this region. If conditions are analogous to those investigated in Arizona the pockets and layers of the rocky soil have a higher moisture content in dry periods than the deep uniform soil has. All evergreen oaks defoliate in the early spring and simultaneously form a complete new crop of leaves. In Chihuahua in 1937, after a dry winter and delayed summer rains, the oaks were nearly leafless in July and new leaves first began to appear early in August. Even in their more favorable habitat the oaks must often be thus brought near the margin of their drought resistance. At such times they might not be able to survive on deep level soil except near streamways.

In northern Coahuila the upper edge of the grassland commonly merges into shrubbery from 1 to 2 meters in height. This vegetation forms a closed cover at slightly higher elevations and on north slopes. It so closely resembles the Pacific coast chaparral in its life forms, social aspects, and generic composition that it may well be designated by the same name. The Mexican chaparral has been described by Muller (3) as manifested on the lower western slopes of Cerro Potosi, in Nuevo Leon. The lower, open edge of the chaparral is dominated in Coahuila by shrubby oaks, notably *Quercus invaginata, Q. cordifolia, Q. Pringlei, Q. hypoxantha,* and *Q. intricata,* or else by small individuals of arborescent species. Commonly associated with the oaks, or locally outnumbering them, are *Cowania plicata, Arctostaphylos pungens, Microrhamnus ericoides, Ceanothus lanuginosus, Mimosa biuncifera, Amelanchier denticulata, Rhus microphylla, Berberis trifoliata* and *Cercocarpus mojadensis.* The prevailing limestone of northern Coahuila is not favorable to the attainment of large size by oaks and pinyons. On steep and moderate slopes the chaparral forms heavy stands and grasses are nearly absent. On level ground and gentle slopes the shrubbery is open and there is a ground cover of grasses and herbs. These circumstances bring about considerable variation in the altitude at which grassland merges into chaparral, and at which chaparral becomes dominant. The changes

most commonly take place between elevations of 1500 to 1800 meters.

Cactus-Acacia-Grassland

Along its southwestern margin the Chihuahuan Desert is bounded by a distinctive type of vegetation which lies between the desert and grassland. This is essentially a thin cover of short grass with a continuous open stand of small trees and tall platyopuntias. The striking physiognomy of this vegetation might suggest that it be designated by the loosely used term "savanna," which is often misapplied to any association of grasses and trees. True savanna is characterized by large harsh-leaved grasses of a type which rarely forms closed communities in temperate North America. The characteristic tree is *Acacia tortuosa,* which usually has a broad flat crown, and the only other tree is a much less frequent undescribed species of *Prosopis.* The platyopuntias are *Opuntia streptacantha* and *O. durangensis,* which are erect, have broad joints 30 to 40 centimeters long, and reach a height of 3 to 6 meters. The cacti usually outnumber the trees but are widely spaced or in open groups. Shrubs are very uncommon and nearly limited to *Celtis pallida* and *Acacia paucispina.* Semi-succulents are sparingly represented by *Yucca carnerosana,* which reaches a height of 5 to 12 meters. Cacti other than those mentioned are very uncommon, the one most frequently seen being the ubiquitous *Opuntia imbricata.* The representation of grasses corresponds closely with that found in the open grassland. Herbaceous perennials are more abundant in species and individuals than they are in the grassland. Many perennial herbs and several grasses grow in the cactus-acacia-grassland which are not found in the grassland. These are largely confined to the heavy shade of the tall opuntias, whereas the light shade of *Acacia,* which executes considerable movement during the day, is occupied by the prevailing sod.

It seems scarcely allowable to regard the cactus-acacia-grassland as a transition between desert and grassland. In physiognomy it carries no suggestion of either. It has most of the typical grasses of the grassland but its flora includes none of the characteristic plants of the desert except the occasional trees of *Prosopis.* Also, the three characteristic large plants are found neither in desert nor grassland.

The lower edge of the cactus-acacia-grassland is reached at about 1800 meters and its upper edge at 2000 meters, or exceptionally as high as 2200 meters. It is found only on plains, bajadas and gently rolling surfaces with soil at least 1 to 2 meters deep. The commonest type of soil is a ruddy brown clay of volcanic origin, containing from 5 to 20 per cent of well worn rock particles from 0.5 to 3 centimeters in diameter. In two localities typical stands were seen on granitic loam (near Sain Alto and near Pinos, in Zacatecas).